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[Title of the Invention]

RADIO COMMUNICATION METHOD AND RADIO COMMUNICATION SYSTEM

[ABSTRACT]

[PURPOSE]

To provide a radio communication method and a radio communication system capable of appropriately setting an optimum modulation system depending on a transmission path.

[SOLUTION]

Judging a communication quality between one radio station and other radio station, an optimum modulation system is decided among at least two modulation systems depending on the communication quality and the data transmission and reception is performed between one radio station and other radio station in the decided modulation system. Then, the communication quality is judged by the use of a signal level and/or an error rate of the received inspection signal. The data between a plurality of radio stations is composed of frames and the inspection signal is transmitted to transmission period of a control signal or to data transmission period in the frame.

[CLAIMS]

[Claim 1]

A radio communication method, whereby transmitting and receiving the data between a plurality of radio stations by air;

wherein, a communication quality between one radio

station and other radio station is judged;

an optimum modulation system is decided among at least two modulation systems depending on said communication quality; and

the data transmission and reception is performed between said one radio station and said other radio station in said decided modulation system.

[Claim 2]

A radio communication method according to claim 1,

wherein, among said at least two modulation systems, one modulation system is a phase modulation and other modulation system is a many-valued modulation.

[Claim 3]

A radio communication method according to claim 1,

wherein said communication quality is judged by the use of a signal level of the received inspection signal.

[Claim 4]

A radio communication method according to claim 1,

wherein said communication quality is judged by the use of an error rate of the received inspection signal.

[Claim 5]

A radio communication method according to claim 1,

wherein said communication quality is judged by the use of a signal level and an error rate of the received inspection signal.

[Claim 6]

A radio communication method according to claim 1,

wherein the data, which is transmitted and received between said plurality of radio stations, is composed of frames and said inspection signal is transmitted to transmission period of a control signal in said frame.

[Claim 7]

A radio communication method according to claim 1,

wherein the data, which is transmitted and received between said plurality of radio stations, is composed of frames and said inspection signal is transmitted to data transmission period in said frame.

[Claim 8]

A radio communication method according to claim 7,

wherein said data transmission period is divided into an isochronous area and an asynchronous area so that said inspection signal is transmitted to said asynchronous area.

[Claim 9]

A radio communication system, whereby transmitting and receiving the data between a plurality of radio stations by air;

wherein said radio station comprises modulation means for setting at least two modulation systems, switching means for switching said at least two modulation systems, means for generating an inspection signal and means for receiving an inspection signal from other radio station and judging a communication quality between the radio station and other radio station; and

said radio station judges a communication quality between one radio station and said radio station, decides an optimum

modulation system among at least two modulation systems depending on said communication quality and transmits and receives the data between one radio station and other radio station in said decided modulation system.

[Claim 10]

A radio communication system according to claim 9,

wherein, among said at least two modulation systems, one modulation system is a phase modulation and other modulation system is a many-valued modulation.

[Claim 11]

A radio communication system according to claim 9,

wherein, said communication quality is judged by the use of a signal level of the received inspection signal.

[Claim 12]

A radio communication system according to claim 9,

wherein, said communication quality is judged by the use of an error rate of the received inspection signal.

[Claim 13]

A radio communication system according to claim 9,

wherein, said communication quality is judged by the use of a signal level and an error rate of the received inspection signal.

[Claim 14]

A radio communication system according to claim 9,

wherein the data, which is transmitted and received between said plurality of radio stations, is composed of frames and said inspection signal is transmitted to transmission

period of a control signal in said frame.

[Claim 15]

A radio communication system according to claim 9, wherein the data, which is transmitted and received between said plurality of radio stations, is composed of frames and said inspection signal is transmitted to data transmission period in said frame.

[Claim 16]

A radio communication system according to claim 15, wherein said data transmission period is divided into an isochronous area and an asynchronous area so that said inspection signal is transmitted to said asynchronous area.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[TECHNICAL FILED TO WHICH THE INVENTION PERTAINS]

The present invention relates to a radio communication method and a radio communication system, which is preferably used to transmit a time-continuous data stream such as the digital audio data and the digital video data and the asynchronous data such as a command between a digital audio appliance and a digital video appliance by air.

[0002]

[PRIOR ART]

The audio appliance and the video appliance have been progressively digitized in recent years as seen in a CD (Compact Disc) player, a MD (Mini Disc) recorder/player, a digital VTR, a digital camera and a DVD (Digital Versatile Disc) player or

the like. Alternatively, due to prevalence of a personal computer, systems capable of controlling variously by the use of the personal computer with being connected to these digital audio appliances and the digital video appliances are appearing. As an interface for building a system such that respective digital audio appliances and the digital audio video appliances are connected in this way or these audio appliances and the personal computer are connected in this way, an IRRR (Institute of Electrical and Electronics Engineers) 1394 has been noted.

[0003]

In the IEEE 1394, an Isochronous transfer mode and an Asynchronous transfer mode are supported. The isochronous transfer mode is preferable for transmitting a time-continuos data stream such as the video data and the audio data or the like at high speed. The asynchronous transfer mode is preferable for transferring, for example, various commands and files. Thus, the isochronous transfer mode and the Asynchronous transfer mode are supported in the IEEE 1394. Therefore, if the IEEE 1394 is used as an interface, the personal computer can easily control the data variously or can easily edit the data by transferring the video data and the audio data between the digital and audio appliances or between the digital video appliances and connecting these appliances with the personal computer.

[0004]

However, the IEEE 1394 is a wired interface. The wiring is required for building the above described system by the wired

interface. Alternatively, the cable thereof becomes complicated. Additionally, in the wired interface, it is difficult to connect the appliances, which are located in the separated rooms in a house.

[0005]

Therefore, it can be considered that the digital audio appliance, the digital video appliance and the personal computer are connected by a wireless LAN (Local Area Network), so that the data communication is established between these appliances by air. As the wireless LAN, a CSMA (Carrier Sense Multiple Access) system and a polling system are known.

[0006]

However, according to a conventional CSMA and a polling system, it is difficult to transfer the data stream such as the video data and the audio data or the like at high speed.

[0007]

Therefore, a wireless LAN supporting the Isochronous transfer mode to transfer the data stream such as the video data and the audio data at high speed and the asynchronous transfer mode to transfer the asynchronous data such as a command and a file or the like and capable of being used as same as the IEEE 1394 has been under development.

[0008]

[TASK TO BE SOLVED BY THE INVENTION]

As a modulation system in the case of establishing the data communication by the wireless LAN, conventionally, a GSMK (Gaussian filtered Minimum Shift Keying) modulation and a QPSK

(Quadrature Phase Shift Keying) modulation are known. Alternatively, in order to improve the transmission rate of the data, the usage of a many-valued modulation system is proposed.

[0009]

According to the many-valued modulation, an amplitude and a phase of a carrier wave are moved simultaneously at a plurality of points. As the many-valued modulation, for example, 16-valued QAM (Quadrature Amplitude Modulation) and 64-valued QAM or the like are known. The many-valued modulation enables the high-speed transmission in a narrower band, so that it is preferable to use the many-valued modulation for transferring the video data and the audio data at high speed.

[0010]

FIG. 9 illustrates a signal point arrangement in the case of the 16-valued QAM modulation. In FIG. 9, a horizontal axis indicates an I axis and a vertical axis indicates a Q axis. As shown in FIG. 9, in the 16-valued QAM modulation, the amplitude and the phase of the carrier wave are moved, so that the signal arrangement is decided.

[0011]

On the contrary, FIG. 10 illustrates a signal point arrangement in the case of the QPSK modulation. As shown in FIG. 10, in the QPSK modulation, the amplitude of the carrier wave is fixed and the phase is only moved.

[0012]

In this way, although the high-speed transmission in a narrower band is available in the many-valued modulation, a

distance between the signals at respective signal points becomes short. Therefore, it has a weakness for a noise and generation of an error becomes a problem under a condition that S (Signal)/N(Noise) ratio is not good. Accordingly, it is advantageous to perform the high speed transmission by the use of the many-valued modulation in a transmission path with a good S/N ratio, however, it is preferable to cope with the error by the use of the modulation system having a long signal distance in the transmission path with a bad S/N ratio.

[0013]

Therefore, it is considered that the modulation system is switched in accordance with a property of the transmission path. However, in a conventional wireless LAN, the modulation system is fixed, so that it was not possible to switch the modulation system in accordance with a property of the transmission path.

[0014]

Accordingly, an object of the present invention is to provide a radio communication method and a radio communication system capable of appropriately setting an optimum modulation system in accordance with a transmission path.

[0015]

[SOLUTION FOR THE TASK]

According to a radio communication system and its transmission method, to which this invention is applied, judging a communication quality between one radio station and other radio station, an optimum modulation system is decided

among at least two modulation systems depending on the communication quality and the data transmission and reception is performed between one radio station and other radio station in the decided modulation system.

[0016]

Then, the communication quality is judged by the use of a signal level and/or an error rate of the received inspection signal.

[0017]

The data between a plurality of radio stations is composed of frames and the inspection signal is transmitted to transmission period of a control signal in the frame or to data transmission period in the frame. Alternatively, the data transmission period is divided into an isochronous transfer mode and an asynchronous transfer mode so that an inspection signal is transmitted to asynchronous transmission period.

[0018]

As described above, judging a communication quality between one radio station and other radio station, an optimum modulation system is decided among at least two modulation systems depending on the communication quality and the data transmission and reception is performed between one radio station and other radio station in the decided modulation system. Therefore, in the case that the S/N ratio of the transmission path is good, the data is transmitted and received by the use of the modulation system capable of performing the high speed transmission such as the many-valued modulation system and in

the case that the S/N ratio of the transmission path is not good, the data is transmitted and received by the use of the modulation system relatively strong to a noise such as the QPSK modulation system.

[0019]

[MODE FOR CARRYING OUT THE INVENTION]

An embodiment according to the present invention will be explained with reference to the drawings below. According to the present invention, a system such as the IEEE 1394 capable of transferring the data stream such as the video data and the audio data and transferring the asynchronous data such as a command by air is constructed. FIG. 1 is a schematic diagram of such a radio network system.

[0020]

In FIG. 1, the reference numerals WN1, WN2, WN3 ... are wireless nodes serving as a communication station. It is possible to connect the digital audio or digital video appliances AV1, AV2, ... such as a CD player, a MD recorder/player, a digital VTR, a digital camera, a DVD player and a television receiver or the like to the wireless nodes WN1, WN2, ... , respectively. Alternatively, a personal computer may be connected to the wireless nodes WN1, WN2, WN3, ... The digital audio or digital video appliances AV1, AV2, ... to be connected to the wireless nodes WN1, WN2, ... are provided with a digital interface of the IEEE 1394 and the digital audio or digital video appliances AV1, AV2, ... are connected by, for example, a digital interface of the IEE 1394.

[0021]

A WNB is a wireless node serving as a control station. The control data is exchanged between the wireless note WNB as the control station and respective wireless nodes WN1, WN2, ... as the communication station. Further, the communication of respective wireless nodes WN1, WN2, ... as the communication station is managed by the wireless note WNB as the control station. Between respective wireless nodes WN1, WN2, ... as the communication station, the time-continuous data stream such as the digital audio and the digital video data (the isochronous data) or the asynchronous data such as a command is exchanged by air.

[0022]

In this way, according to this example, a wireless LAN is constructed in the star-shaped topology as shown in FIG. 2. The star-shaped topology is composed of a center control station CN and peripheral terminal stations TN1, TN2, ... and the exchange of the data between respective terminal stations TN1, TN2, ... is managed by the center control station CN. The center control station CN corresponds to the wireless node WNB and the terminal stations TN1, TN2, ... correspond to the wireless nodes WN1, WN2, ... Alternatively, a constitution of the wireless LAN is not limited to such star-shaped topology.

[0023]

Between the wireless nodes WN1, WN2, ... and the wireless node WNB, the control data, the time-continuous data stream such as the digital audio and the digital video and the asynchronous

data such as a command are transmitted. These data are transmitted in a frame constitution as shown in FIG. 3.

[0024]

In other words, FIG. 3 illustrates a frame constitution of the data to be transmitted between the wireless nodes WN1, WN2, ... and the wireless node WNB. As shown in FIG. 3, at a head of one frame, a control area MA to transmit the managing information such as the network information or the like is arranged. Then, following this control area MA, a street packet transmission area SPA and an asynchronous transmission area ASYNCA to perform the asynchronous transfer are arranged. The street packet transmission area SPA and the asynchronous transmission area ASYNCA serve as a data transmission area.

[0025]

The street packet transmission area SPA establishes the high speed communication corresponding to the isochronous transfer mode of the IEEE 1394. The street packet transmission area SPA is constructed by time slots SL1, SL2, ... The time slots SL1, SL2, ... serve as a unit for time-division multiplexing and the slots are arranged for each predetermined time. According to this example, for example, the number of the time slots SL1, SL2, ... is assumed as sixteen. By transmitting the data stream by the use of the time slots SL1, SL2, ... , which are different mutually, for example, it is possible to transfer the sixteen data streams simultaneously.

[0026]

Alternatively, according to the above described example,

the number of the time slots is assumed as sixteen. However, its number is not limited to this and its position may be set at an arbitrary position in a frame.

[0027]

In this way, in the street packet transmission area SPA, the data stream is transmitted by the use of the time slots SL1, SL2, ... In this case, the number of the time slots SL1, SL2, ... to be used in one data stream is not fixed. For example, a bit rate of the data stream of MPEG2 is changed depending on a picture and a motion or the like. In the case that a volume of the information of the data stream is large, the number of the time slots SL1, SL2, ... to be used in one data stream is increased and in the case that a volume of the information of the data stream is small, the number of the time slots SL1, SL2, ... to be used in one data stream is decreased.

[0028]

Alternatively, according to the transmission of the street packet transmission area SPA, the control to re-transfer the data is not performed in need of the high speed communication. Therefore, adding an error correcting code to code a block, an error is treated.

[0029]

The asynchronous transmission area ASYNCA corresponds to the asynchronous transmission mode of the IEEE 1394 and it is used for transferring the asynchronous data such as a command. According to the transmission in this asynchronous transmission area ASYNCA, an acknowledgement to be returned from the opposite

side is confirmed so that the transmission without an error can be performed. Then, if the acknowledgement is not returned from the opposite side, the transmission in this asynchronous transmission area ASYNCA is controlled so as to re-transmit the data.

[0030]

As the transmission control in the asynchronous transmission area ASYNCA, for example, a method is considered such that the transmission is controlled by the polling operation from the wireless node WNB of the center control station to the wireless nodes WN1, WN2, ... of respective communication stations or by detecting a carrier, the transfer is controlled so that the transmission demand and the collision are not generated from other nodes on the transmission path.

[0031]

The allocation of the time slots SL1, SL2, ... upon transmitting the data stream between respective wireless nods WN1, WN2, ... is performed by the wireless node WNB as a control station.

[0032]

In other words, the wireless node WNB as a control station manages the communication state in the system and it recognizes the time slot in use at the present time. Alternatively, the managing information is transmitted from the wireless node WNB as a control station. By this managing area information, respective wireless nods WN1, WN2, ... are capable of judging for what communication which of the time slot SL1, SL2, ... are used.

[0033]

The wireless node WNB as a control station establishes the polling communication with respect to the wireless nodes WN1, WN2, ... as a communication station. If the transfer demand of the data stream is transmitted from a certain wireless node WN1, WN2, ..., this transfer demand is transferred to the wireless node WNB as a control station by the polling communication. The wireless node WNB as a control station allocates the time slot SL1, SL2, ... in the wireless node WN1, WN2, ..., which is demanded for the data transmission as well as the information of the newly allocated time slot SL1, SL2, ... is transmitted to other wireless node WN1, WN2, ... The wireless node WN1, WN2, ... , which are demanded for the data transmission, transfers the data stream by the use of this allocated time slot SL1, SL2, ...

[0034]

Alternatively, according to this example, as shown in FIG. 4, a communication quality inspection signal Q-TEST, an inspection result signal Q-REV and a modulation information signal M-INFO are transmitted to the control area MA at a head of respective frames. The communication quality inspection signal Q-TEST becomes the inspection signal to inspect a property of the transmission path. The inspection result signal Q-REV is a signal to indicate a reception result of this communication quality inspection signal Q-TEST. The modulation information signal M-INFO is a signal to indicate an available modulation system in this communication station WN1, WN2, ...

[0035]

Thus, the communication quality inspection signal Q-TEST is transmitted to the control area MA. The communication quality inspection signal Q-TEST is capable of deciding the modulation system upon establishing the communication between the wireless nods WN1, WN2, ... of respective communication terminals by the use of this communication quality inspection signal Q-TEST.

[0036]

In other words, the communication quality inspection signal Q-TEST is transmitted from the wireless nods WN1, WN2, ... as a communication station to the control area MA. The wireless node WN1, WN2, ... as a communication station other than the stations transmitting the communication quality inspection signal Q-TEST receives this communication quality inspection signal Q-TEST. Then, the wireless node WN1, WN2, ... as a communication station other than the stations transmitting the communication quality inspection signal Q-TEST judges the receiving level of this communication quality inspection signal Q-TEST. Further, the wireless node WN1, WN2, ... as a communication station other than the stations transmitting the communication quality inspection signal Q-TEST judges a property of the transmission path between the wireless node WN1, WN2, ... and a station transmitting the communication quality inspection signal Q-TEST from a signal level of the communication quality inspection signal Q-TEST.

[0037]

For example, from the wireless node WN1 in FIG. 1, the communication quality inspection signal Q-TEST is transmitted. The communication quality inspection signal Q-TEST, which has been transmitted from the wireless node WN1, is received by other wireless node WN2, WN3, WN4, … . In this case, in the wireless node WN2, WN5, which are adjacent to the wireless node WN1, a level of receiving the communication quality inspection signal Q-TEST from the wireless node WN1 is large. However, in the wireless node WN4, WN5, which is separated from the wireless node WN1, a level of receiving the communication quality inspection signal Q-TEST from the wireless node WN1 is small. Accordingly, by receiving the communication quality inspection signal Q-TEST from the wireless node WN1, it is possible to judge a quality of the transmission path between the wireless node WN1 and other wireless node WN2, WN3, … .

[0038]

In the same way, from the wireless node WN2, WN3, WN4, … , the communication quality inspection signal Q-TEST is transmitted. Then, this communication quality inspection signal Q-TEST is received by other wireless node WN2, WN3, WN4, … . Then, from the receiving level of this communication quality inspection signal Q-TEST, it is possible to judge a quality of the transmission path between the wireless nodes WN2, WN3, WN4, … .

[0039]

In the case that the data is transmitted between respective wireless nodes WN1, WN2, WN3, … , in response to the

quality of the transmission path judged in this way, the modulation system is decided.

[0040]

In other words, for example, it is assumed that the QPSK modulation and the many-valued modulation are capable of being set. Then, it is assumed that the data is transmitted and received between the wireless node WN1 and the wireless node WN2. In this case, the wireless node WN1 is adjacent to the wireless node WN2 and a receiving level of the communication quality inspection signal Q-TEST from the wireless node WN1 is large, so that it is judged that its S/N ratio of the transmission path is good. Accordingly, in this case, a modulation system is set as the many-valued modulation system, whereby the high speed transmission ratio is obtained.

[0041]

On the contrary, it is assumed that the data is transmitted and received between the wireless node WN1 and the wireless node WN4. In this case, the wireless node WN1 and the wireless node WN4 are separated and the receiving level of the communication quality inspection signal Q-TEST from the wireless node WN1 is small, so that it is judged that the S/N ratio is not good from the transmission quality information. Accordingly, in this case, the modulation system is set as the QPSK modulation system, in which the error is hardly generated even if the S/N ratio is not good.

[0042]

Alternatively, transmitting the receiving level of the

communication quality inspection signal Q-TEST to the control station WNR as the inspection result signal Q-REV, a list indicating the quality state of respective transmission paths may be formed in the control station WNB.

[0043]

Additionally, according to the above described example, a property of the transmission path is judged from the receiving level of the communication quality inspection signal Q-TEST, however, the property of the transmission path may be judged from an error rate of the receiving signal. Alternatively, it may be judged by the use of the both of the receiving signal level and the error rate.

[0044]

FIG. 5 is a flow chart for illustrating the above described processing. FIG. 5A illustrates the operation of the communication station side and FIG. 5B illustrates the operation of the control station side.

[0045]

In FIG. 5, in the control area MA upon starting the frame, one wireless node transmits the communication quality inspection signal Q-TEST and other wireless node receives this communication quality inspection signal Q-TEST (step S101). It is possible to judge a quality of the transmission path from the receiving level of this communication quality inspection signal Q-TEST (step S100).

[0046]

The wireless node at the control station side establishes

the polling communication with respect to respective communication stations (step S121) and then, it terminates the processing.

[0047]

The wireless node at the control station side is waiting for a polling signal addressed to this wireless node (step S102). If the wireless node receives the polling, it judges whether there is the transmission data or not (step S103). If there is the transmission data, the wireless node will transmit the data (step S104). Then, judging whether the frame attains the end or not (step S105), if the frame does not attain the end, the wireless node will return to the step S102. If the frame attains the end, the wireless node will terminate the processing.

[0048]

As described above, in the control area MA, one wireless node transmits the communication quality inspection signal Q-TEST and other wireless node receives this communication quality inspection signal Q-TEST. A quality of the transmission path is judged from the receiving level of this communication quality inspection signal Q-TEST. In the case that the data is transmitted and received between the communication stations mutually, depending on the quality of the transmission path, which is judged in this way, an available modulation system is exchanged.

[0049]

FIG. 6 is a flow chart for illustrating the processing

for deciding a modulation system between respective communication stations upon establishing the communication between the wireless nodes WN1, WN2, … . FIG. 6A illustrates the processing of the communication station at the side, which desires the communication. FIG. 6B illustrates the processing of the communication station at the other party's side of the communication.

[0050]

As shown in FIG. 6, at first, the wireless node of one communication station sets the modulation system at the first modulation system (for example, the QPSK modulation) and it transmits the information in the modulation system available upon the reception on the basis of the quality of the transmission path, which is obtained as described above (step S201).

[0051]

The communication station of the other party's side receives the demodulation system available upon the transmission (step S221). If the communication station of other party's side receives the demodulation system available upon the transmission, it will transmit the modulation system available upon the transmission (step S222) and it terminates the processing.

[0052]

If the wireless node of one communication station transmits the modulation system available upon the reception, it judges whether a signal from the other party's side of the

communication is received or not (step S202). Then, if a signal from the other party's side of the communication is received, the wireless node of one communication station receives the modulation system available upon the transmission (step S203) and it terminates the processing.

[0053]

As described above, the system applied with this invention receives the communication quality inspection signal Q-TEST upon establishing the communication between the wireless nodes WN1, WN2, ... and an optimum modulation system is decided from this receiving level. Therefore, in the case that the S/R ratio of the transmission path is not good, it is possible to improve the error rate by the use of the QPSK modulation.

[0054]

According to the above described example, in the control area at a head of respective frames, the communication quality inspection signal Q-TEST. However, as shown in FIG. 7, transmitting the communication quality inspection signal in the data transmission area, the modulation system may be decided.

[0055]

In other words, FIG. 7 illustrates an example in the case that a communication quality inspection signal is transmitted in a data transmission area to decide a modulation system. FIG. 7A illustrates the processing of a wireless node at a first communication station's side. FIG. 7B illustrates the processing of a wireless node at a second communication station's side.

[0056]

As shown in FIG. 7A and FIG. 7B, at first, the wireless node of the first communication station and the wireless node of the second communication station are set in the first modulation system together and the wireless node of the first communication station transmits the communication quality inspection signal to the wireless node of the second communication station in the data transmission area (step S301). As this communication quality inspection signal, for example, a PN (Pseudo Noise) code is used.

[0057]

As shown in FIG. 8B, the wireless node of the second communication station receives this communication quality inspection signal (step S321) and evaluates a quality of the received communication quality inspection signal by the use of the error rate and the signal strength (step 322). Then, considering the quality of the received communication quality inspection signal, the wireless node of the second communication station transmits the modulation system available upon the reception (step S323).

[0058]

As shown in FIG. 8A, the wireless node of the first communication station judges whether a signal is transmitted from the second communication station or not (step S302). Then, if the signal is received, the wireless node of the first communication station obtains the modulation system available upon the transmission, evaluates the receiving quality of this

signal (step S303) and transmits the modulation system available upon the reception (step S304).

[0059]

The wireless node of the second communication station judges whether a signal is transmitted from the first communication station or not (step S324). Then, if the signal is received, the wireless node of the first communication station receives the modulation system available upon the transmission (step S325), it transmits an acknowledge signal (step S326) and it terminates the processing.

[0060]

The wireless node of the first communication station judges whether the acknowledge signal is transmitted from other party or not (step S305). If the acknowledge signal is transmitted from other party, the wireless node of the first communication station receives this acknowledge signal (step S306) to terminate the processing.

[0061]

Thus, the communication quality inspection signal is transmitted in the data transmission area upon establishing the communication between the wireless nodes serving as the communication stations, so that it is possible to decide an optimum modulation system. Alternatively, as described above, the data transmission area is divided into the stream packet transmission area SPA and the asynchronous transmission area ASYNCA. For example, the communication quality inspection signal is transmitted in the asynchronous transmission area

ASYNCA.

[0062]

FIG. 8 explains a constitution of the wireless node WN1, WN2, ... and WNB capable of corresponding to a plurality of modulation systems. A constitution of the wireless node WNB as the control station is the same as that of the wireless node WN1, WN2, ... as the communication station basically.

[0063]

As shown in FIG. 8, respective wireless nodes WN1, WN2, ... and WNB are provided with a digital interface 11 of the IEEE 1394. In the digital interface 11 of the IEEE 1394, the time-continuous data (isochronous data) such as the digital audio data and the digital video data or the like and the asynchronous data such as a command or the like are supported.

[0064]

Alternatively, respective wireless nodes WN1, WN2, ... and WNB are provided with a coding/decoding unit 12, two modulation/demodulation units 13A and 13B, a high frequency transmission processing unit 14, a transmission control and managing unit 15 and a measuring unit 16. Additionally, in order to switch two modulation/demodulation units 13A and 13B, selectors 17 and 18 are provided.

[0065]

The coding/decoding unit 12 performs the encoding processing of the transmission data and the decoding processing of the reception data. In the transmission of the data stream, the coding/decoding unit 12 performs the error correction

coding processing with respect to a data stream to be transmitted by a block code. Alternatively, the error collecting processing is performed with respect to the reception data.

[0066]

The modulation/demodulation units 13A and 13B performs the modulation processing of the transmission data and the demodulation processing of the reception data. As the modulation/demodulation unit 13A and the modulation/demodulation unit 13B, the different modulation systems are used. For example, as the modulation system of the first modulation/demodulation unit 13A, the QPSK is used and as the modulation system of the first modulation/demodulation unit 13B, the many-valued modulation system, for example, the 16-valued QAM is used.

[0067]

The high frequency transmission processing unit 14 converts the transmission signal into a predetermined frequency and amplifies the electric power into a necessary electric power as well as it takes out a signal with a predetermined frequency from the reception signal and then, it converts it into a signal with a middle frequency. Alternatively, the transmission signal may be modulated secondarily in the spectrum diffusion and OFDM (Orthogonal Frequency Division Multiplexing).

[0068]

The transmission control and managing unit 15 manages the data transmission. In other words, as described above, in this

system, the data is transmitted in the frame constitution and the data stream such as the digital video data or the like is transmitted by the use of a time slot. Alternatively, in the asynchronous transmission, it is confirmed whether the data arrives or not by the acknowledgement. Then, if it does not arrive, the processing is performed to perform the re-transmission. The transmission control and managing unit 15 performs such processing for the data transmission.

[0069]

Alternatively, according to this example, the two modulation/demodulation units 13A and 13B are arranged. For example, by the communication quality inspection signal Q-TEST of the control area MA at a head of each frame, an inspection result signal D-MOD and a inspection response signal Q-ACK, two modulation systems are appropriately set. In this case, the processing is performed by the transmission control and managing unit 15 and these signals are outputted from the transmission control and managing unit 15. Then, by a control signal from the transmission control and managing unit 15, the selectors 17 and 18 are appropriately switched and the two modulation/demodulation units 13A and 13B are appropriately switched. Alternatively, in the transmission control and managing unit 15, a storage unit is provided to store a list of the modulation system for indicating which modulation system is used in which transmission is stored.

[0070]

The measuring unit 16 evaluates whether the communication

in the present modulation system is available or not from the signal strength and the error rate of the received signal. This evaluation result is transmitted to the transmission control and managing unit 15 to be used by the transmission control and managing unit 15 for deciding the modulation system.

[0071]

In the control area MA, the selectors 17 and 18 are set at a predetermined modulation system side, for example, the side of the modulation/demodulation unit 13A. In the case that the street packet transmission area SPA and the asynchronous transmission area ASYNCA transmit the data stream and the asynchronous data, the transmission control and managing unit 15 appropriately sets the selectors 17 and 18.

[0072]

In the case of transmitting the data, the data inputted through the interface 11 is transmitted to the coding/decoding unit 12. Then, the coding/decoding unit 12 encodes the data. The output from this coding/decoding unit 12 is supplied to the modulation/demodulation unit 13A in the QPSK modulation or the modulation/demodulation unit 13B in the 1 many-valued modulation through the selector 17.

[0073]

As described above, the selector 17 is set at the side of the modulation/demodulation unit 13A in the control area MA. Further, the selector 17 is appropriately set at the side of the modulation/demodulation unit 13A and at the side of the modulation/demodulation unit 13B in the street packet

transmission area SPA and the asynchronous transmission area ASYNCA in the case of transmitting the data stream and the asynchronous data.

[0074]

The data, which is modulated by the modulation/demodulation unit 13A or 13B, is supplied to the high frequency transmission processing unit 14 through the selector 18. A frequency of this signal is converted to a predetermined transmission frequency, an electric power thereof is amplified to a necessary electric power to be outputted from an antenna 19.

[0075]

In the case of receiving the data, a signal from the antenna 19 is transmitted to the high frequency transmission processing unit 14. The high frequency transmission processing unit 14 converts the reception signal into a predetermined middle frequency signal. The output from this high frequency transmission processing unit 14 is transmitted to the modulation/demodulation unit 13A or 13B through the selector 18 and the modulation/demodulation unit 13A or 13B performs the demodulation processing of the reception signal.

[0076]

The data, which is demodulated by the modulation/demodulation unit 13A or 13B, is supplied to the coding/decoding unit 12 through the selector 17. The coding/decoding unit 12 performs the error collecting processing or the like and the data is demodulated. The

demodulated data is outputted through the digital interface 11.

[0077]

Alternatively, according to this example, the two modulation/demodulation unit 13A or 13B are arranged. However, further, a plurality of modulation/demodulation units may be arranged. Alternatively, the modulation systems in respective modulation/demodulation systems are not limited to the QPSK modulation and the many-valued modulation.

[0078]

[Effect of the Invention]

According to this invention, judging the communication quality between one radio station and other radio station, an optimum modulation system among at least two modulation systems is decided depending on the communication quality, so that the data is transmitted and received between one radio station and other radio station in the decided modulation system. Therefore, in the case that the S/N ratio of the transmission path is good, the data is transmitted and received by the use of the modulation system capable of performing the high speed transmission such as the many-valued modulation. On the contrary, in the case that the S/N ratio of the transmission path is not good, the data is transmitted and received by the use of the modulation system relatively strong to a noise such as the QPSK modulation system. Hereby, if the S/N ratio of the transmission path is good, the high speed data transmission becomes available and if the S/N ratio of the transmission path is not good, it is possible to improve the error rate.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1]

FIG. 1 is a schematic diagram for illustrating an example of a radio network system, to which the present invention is applied.

[FIG. 2]

FIG. 2 is a schematic diagram for explaining a star-shaped network system.

[FIG. 3]

FIG. 3 is a schematic diagram for explaining a constitution of one frame in a radio network system.

[FIG. 4]

FIG. 4 is a schematic diagram for explaining a signal to be transmitted in order to decide a modulation system.

[FIG. 5]

FIG. 5 is a flow chart for explaining the operation of a frame.

[FIG. 6]

FIG. 6 is a flow chart for explaining an example of deciding a modulation system.

[FIG. 7]

FIG. 7 is a flow chart for explaining another example of deciding a modulation system.

[FIG. 8]

FIG. 8 is a block diagram for showing an example of a wireless node in a radio network system, to which the present invention is applied.

[FIG. 9]

FIG. 9 is a vector view for explaining a 16-valued QAM modulation.

[FIG. 10]

FIG. 10 is a vector view for explaining a QPSK modulation.

[EXPLANATION OF REFERENCE NUMERALS]

12: coding/decoding unit

13A, 13B: modulation/demodulation unit

15: transmission control and managing unit

16: measuring unit

FIG. 3

CONTROL AREA

STREAM PACKET TRANSMISSION AREA

ONE FRAME

ASYNCHRONOUS TRANSMISSION AREA

FIG. 4

Q-TEST COMMUNICATION QUALITY

INSPECTION SIGNAL

Q-REV INSPECTION RESULT SIGNAL

MOD-INFO MODULATION INFORMATION

FIG. 5A

FRAME START,

101 TRANSMIT INSPECTION SIGNAL AND RECEIVE INSPECTION SIGNAL OF OTHER COMMUNICATION STATION

102 PALLING SIGNAL IS RECEIVED?

103 THERE IS TRANSMISSION DATA?

104 TRANSMIT DATA

105 FRAME END?

END

FIG. 5B

FRAME START

121 PALLING, END

FIG. 6A

START

201 TRANSMIT MODULATION MEANS AVAILABLE UPON RECEPTION BY USING FIRST MODULATION SYSTEM

202 THERE IS RESPONSE FROM OTHER PARTY OF COMMUNICATION?

203 RECEIVE MODULATION SYSTEM AVAILABLE UPON TRANSMISSION

END

FIG. 6B

START

221 RECEIVE DEMODULATION SYSTEM AVAILABLE UPON TRANSMISSION

222 TRANSMIT MODULATION MEANS AVAILABLE UPON RECEPTION

END

FIG. 7A

START

301 TRANSMIT COMMUNICATION QUALITY INSPECTION SIGNAL

302 THERE IS RESPONSE FROM OTHER PARTY OF COMMUNICATION?

303 OBTAIN MODULATION SYSTEM AVAILABLE UPON TRANSMISSION AND EVALUATE RECEIVING QUALITY

304 TRANSMIT MODULATION SYSTEM AVAILABLE UPON RECEPTION

305 THERE IS RESPONSE FROM OTHER PARTY OF COMMUNICATION?

306 RECEIVE ACKNOWLEDGEMENT

END

FIG. 7B

START

321 RECEIVE COMMUNICATION QUALITY INSPECTION SIGNAL

322 EVALUATE RECEIVING QUALITY

323 TRANSMIT MODULATION SYSTEM AVAILABLE UPON RECEPTION

324 THERE IS RESPONSE FROM OTHER PARTY OF COMMUNICATION?

325 RECEIVE MODULATION SYSTEM AVAILABLE UPON TRANSMISSION

326 TRANSMIT ACKNOWLEDGEMENT

END

FIG. 8

12 CODING/DECODING

15 CONTROL AND MANAGING

16 MEASUREMENT

18A QPSK MODULATION/DEMODULATION

18B MANY-VALUED MODULATION/DEMODULATION